Center Independent Research & Development: GRC IRAD

FY17 GRC: Supercritical Water Plasma-Assisted Oxidation

Completed Technology Project (2017 - 2017)

Project Introduction

Closed-loop systems for waste stream processing and resource reclamation (e.g., solid waste management and water reclamation) remain a limiting factor for extended duration space missions contemplated under NASA's exploration initiative. Current systems are constrained by their recovery efficiencies, total system masses, operational and maintenance costs, waste stream preconditions, and the inability to address the full spectrum of microbial and organic contaminants. Supercritical Water Oxidation (SCWO) provides an established technology base that has the potential to successfully address many, if not all, of these issues through the application of a number of recent advances. The overarching goal of the proposed work was to demonstrate the efficacy of partially converting one of the reactant streams from a co-flow SCWO injector into plasma in order to initiate and/or accelerate the oxidation reactions.

Anticipated Benefits

The benefits derived by this technology could be considerable and highly relevant to NASA's needs, particularly in the areas of Environmental Control and Life Support (i.e., waste management and water reclamation) and Space Life and Physical Sciences (i.e., gain of fundamental knowledge in plasma physics). There are many terrestrial applications that would potentially benefit, should the proposed technology be successful. In a horizon of 5 to 10 years, plasma-assisted SCWO would be patented and conceivably become the seed technology for a commercial start-up. Considering a longer time horizon, because of the dire needs on a wide front of environmental and resource issues, it is not inconceivable that this technology becomes ubiquitous. Timely examples include applications in the reclamation of contaminated water resources; e.g., algae blooms in Lake Erie, handling ballast-water from shipping, salt-laden aquifers in the Southwest. More traditional examples include the handling of “wet” solid-waste streams; ranging from the typical (e.g., city sludge, commercial farm wastes, etc.) to the more problematic (e.g., pharmaceutical, cooling wastes from nuclear power plants, paper mills, demilitarization of chemical weapon stockpiles, etc.). A number of new applications are also emerging; e.g., hydrothermal flame spallation for drilling, or partial oxidation of shale oil in supercritical water to reduce coking during reforming.

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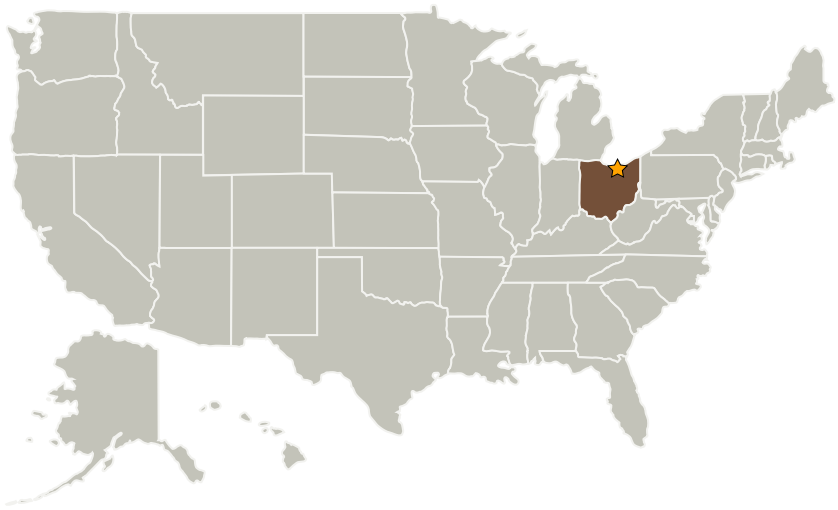
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
FGC Plasma Solutions	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Lemont, Illinois

Primary U.S. Work Locations
Ohio

Project Transitions

May 2017: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Center Independent Research & Development: GRC IRAD

Project Management

Program Manager:

Gary A Horsham

Project Manager:

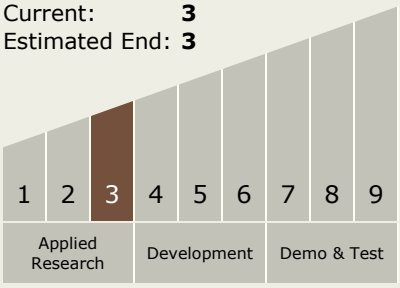
Michael C Hicks

Principal Investigator:

Michael C Hicks

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



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November 2017: Closed out

Closeout Summary: GRC considers this technology to be ready for adoption wi thin the GRC microgravity experiments projects portfolio. The GRC Research and Engineering Directorate will support the accomplishment of this objective.

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.5 ECLSS Modeling and Simulation Tools

Target Destinations

Earth, The Moon, Mars

Supported Mission Type

Push